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(71)Applicant : ASAHI GLASS CO LTD

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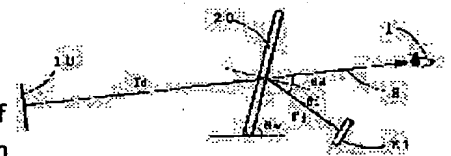
(72)Inventor : NAKAZAWA OSAHITO
SAKURAI HIROMI

(54) HOLOGRAPHIC DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a holographic display device without blur by chromatic aberration even by using fluorescent display tube by providing a fluorescent display tube to an information display source and using specific phosphor for this fluorescent display tube.

SOLUTION: Light 3 containing information from an information display source provided with a fluorescent display tube 21 is diffracted by a combiner 20 comprised of a substrate with a hologram formed thereon and visually recognized by an observer 1 as a virtual display image 10. Here, as phosphor of the fluorescent display tube 21, ZnGa₂O₄:Mn is used. Contrasted with a 100nm or longer half-value width of an emission spectrum of a phosphor ZnO:Zn which is generally used, ZnGa₂O₄:Mn phosphor has an about 25nm of a half-value width of the emission spectrum, therefore, generation of chromatic aberration is reduced to a quarter or less than that of conventional one, and a sufficiently permissible display image is obtained. As a display pattern, phosphor may be patterned and arranged in a segment form, but a dot matrix type is more desirable because it can display a higher degree of information.



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CLAIMS

[Claim(s)]

[Claim 1] Said source of an information display is equipped with the fluorescent display in the holographic display equipped with the combiner which has the source of an information display which generates as a light the information which should be displayed, and the hologram which is allotted to the base material and this base material, turns and diffracts said light to an observer, and is displayed as a virtual image at least, and the fluorescent substance of this fluorescent display is ZnGa 2O₄ .

Holographic display characterized by being Mn.

[Claim 2] The holographic indicating equipment according to claim 1 characterized by dedicating said source of an information display to the body section of an indicating equipment, and said combiner being supported to revolve by the body section free [rotation] [near / the / the lower side].

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a holographic display.

[0002]

[Description of the Prior Art] The product using a hologram is increasing by progress of a hologram ingredient in recent years and a laser technique. For example, in the holographic display which diffracts light including information and displays information on an observer, the hologram is used as an optical element. Moreover, the mark for forged prevention of an ID card or a credit card, and the hologram for an ornament and the hologram which recorded the image in the hologram calendar are used.

[0003] There are the following as a concrete example. As an approach of displaying information on the operator of cars, such as an automobile, displays, such as a HUD (it is called Following HUD), are used recently. This projects the optical information on which it was projected from information delivery systems, such as a liquid crystal display, on the combiner which consists of a hologram included in the windshield of an automobile etc., a half mirror, etc., and it enables it to read information, without an operator almost moving a view from operational status.

[0004] Since especially the thing using the hologram as a combiner can set up an incident angle and an angle of diffraction freely and it not only can diffract optical information, but it can have a lens function etc. toward an operator, optical information is diffracted to an operator's lines of sight, or optical system of a lens etc. is not used for others, but it can carry out image formation to the location of arbitration. Moreover, since the half-value width of a diffraction spectrum is narrow, it has the description that the display image of high brightness is obtained without spoiling foreground brightness, and is effective as a combiner of an indicating equipment.

[0005] Drawing 4 is the conceptual diagram showing an example of conventional HUD. The light 3 including the information which emitted from the light source 6 and passed the transparency mold liquid crystal display component 5 through the lens system 4 and the wavelength selection filter 11 and which should be displayed is irradiated and diffracted by the hologram 2 with which the windshield 7 of a car body was equipped, and is checked by looking by the operator in the observation location 1. The above-mentioned lens system 4 has a function as a collimator. At this time, a windshield 7 is a glass laminate and the hologram 2 is enclosed in this glass laminate. Moreover, the display of the multicolor image to wish to have is attained by a hologram's 2 having a wavelength optional feature and using the hologram which carried out multiplex exposure. For example, it becomes possible by giving the rate indication 8 to green and making an alarm display 9 into red to transmit information more exactly to an operator.

[0006]

[Problem(s) to be Solved by the Invention] However, in order that a hologram may use diffraction, dotage of the image by generating of chromatic aberration poses a problem. Then, the cathode-ray tube with wavelength half-value width narrow (about 6nm) as the light source of a transparency mold liquid crystal display component needed to be used conventionally, and the interference filter with narrow wavelength half-value width needed to be used like the above-mentioned example. When using a cathode-ray tube as the light source, an inverter circuit is needed and about [being expensive] and a brilliance control (modulated light) is also difficult. Also in an interference filter, multilayer coating is needed and the filter with high transmission with narrow half-value width is dramatically expensive.

[0007] Moreover, although it is necessary to double the peak wavelength and diffracted-wave length of a hologram when using the light source with narrow half-value width, this also needs the precise production technique of a hologram. When playback wavelength was changed by the manufacture variation of a hologram or an interference filter, there was also a trouble that the brightness of a display image will fall. Furthermore, even if ideal wavelength adjustment is attained, there is a problem of the temperature characteristic. When the diffracted-wave length of a hologram was changed by the environmental temperature change, there was a problem that the brightness of a display image will fall too.

[0008] The object of this invention is to solve the above-mentioned technical problem which the conventional technique had, and is to offer newly the holographic display which was not known conventionally.

[0009]

[Means for Solving the Problem] The source of an information display which generates as a light the information which it is made and should be displayed that this invention should solve the above-mentioned technical problem, In the holographic display equipped with the combiner which has the hologram which is allotted to the base material and this base material, turns and diffracts said light to an observer, and is displayed as a virtual image at least Said source of an information display is equipped with the fluorescent display, and the fluorescent substance of this fluorescent display is ZnGa_2O_4 . : The holographic display characterized by being Mn is offered.

[0010]

[Embodiment of the Invention] Hereafter, based on a drawing, this invention is further explained to a detail. Drawing 1 is the outline sectional view showing an example of the holographic display of this invention.

- [0011] The light 3 including the information from the source 21 of an information display equipped with the fluorescent display is diffracted by the combiner 20 which it comes to match for a base material a hologram, and is checked by looking by the observer 1 as a display virtual image 10. It is the description to use $\text{ZnGa}_2\text{O}_4\text{:Mn}$ as a fluorescent substance of a fluorescent display 21 in this invention.
- [0012] ZnGa_2O_4 used for drawing 2 by this invention : The emission spectrum of the fluorescent display of Mn fluorescent substance and the zinc-oxide (ZnO:Zn) fluorescent substance currently generally used conventionally is shown. The half-value width of the emission spectrum of the conventional ZnO:Zn fluorescent substance is 100nm or more. On the other hand, ZnGa_2O_4 used by this invention : The half-value width of the emission spectrum of Mn fluorescent substance is about 25nm (peak wavelength is about 505nm). Therefore, in the holographic display of this invention, generating of chromatic aberration becomes below the conventional quadrant, and a permissible enough display image is obtained.
- [0013] Thus, if this invention is used, an expensive liquid crystal display component, a cathode-ray tube, or an interference filter is not used like before, but a comparatively cheap fluorescent display can realize a holographic display. Moreover, since the light source with wide half-value width can be used compared with a cathode-ray tube, even if it changes the diffracted-wave length of a hologram somewhat for manufacture variation or the temperature characteristic, big brightness lowering does not occur.
- [0014] The fluorescent display which can set this invention is $\text{ZnGa}_2\text{O}_4\text{:Mn}$. It considers as a fluorescent substance. Although a fluorescent substance may be patternized as a pattern of a display and you may arrange in the shape of a segment, the array of a dot-matrix mold is more desirable at the point which can display more advanced information.
- [0015] The combiner in this invention consists of what was matched for the base material with the hologram. What is usually the area of several 100mm [several 10mm to] angle extent, and has the thickness of several micrometers to about several 10 micrometers as a hologram is illustrated.
- [0016] In that the hologram of the volume and phase molds, such as a lip man type, can acquire high diffraction efficiency, although this hologram is desirable, what is called holograms, such as an embossing type and a rainbow type, can be widely used for it. And in a transparency mold, a reflective mold, etc., especially a limit does not have the type of a hologram, either. As a hologram ingredient, various sensitive material, such as photopolymers, such as acrylic and a polyvinyl carbazole, dichromated gelatin, photoresist, and silver salt, can be used.
- [0017] The base material in this invention is suitably chosen according to an application or a busy condition. To a hologram, although it cannot be overemphasized that the incidence [of playback light] and outgoing radiation side of the diffracted light is a transparent base material, this may penetrate light selectively. For example, the transparency glass plate which is not coloring, and the glass plate stained in addition to this in bronze, Green, etc. can also be used as a base material. Moreover, the part which neither playback light nor the diffracted light passes may be opaque.
- [0018] As construction material of a base material, resin substrates, such as an acrylic besides glass, a polycarbonate, a polyvinyl chloride, and polyolefine, may be used, and you may be a transparent crystalline etc. Moreover, a film with a thickness [besides a plate with a thickness of several mm] of 1mm or less is sufficient also about the thickness of a base material, and you may be a block object with a thickness of several cm. Antireflection coating and hard coating may be given to the front face of these base materials if needed.
- [0019] Furthermore, optical members, such as a lens and a mirror, an optical polarization means, or a nonlinear optical element may be arranged in an optical trajectory until it is projected on light by the hologram if needed.
- [0020] The holographic display of this invention is appropriately used also in HUD for automobiles like the conventional example shown in drawing 4 . Moreover, a combiner is supported to revolve by the body section equipped with the source of an information display, and it is laid on the dashboard of a car, and can be used more preferably as a mold HUD (refer to drawing 3) every so-called exception which

makes an operator etc. check operation information by looking. In unifying the source of an information display, and the combiner, it is because the conventional source of an information display consists of combination of the light source and a transparency mold liquid crystal display component, a fluorescent display has both functions alone compared with having been large-sized, so a small and lightweight holographic display is realizable. Every exception [this], if a resin ingredient is used as a base material of a combiner in Mold HUD, even if it should become lightweight compared with glass and should collide, it is desirable at the point of being hard to damage a combiner.

[0021] Every exception [this], an example of Mold HUD is shown in drawing 3. The combiner 20 is supported to revolve by the body section 22 of HUD free [rotation] through the attachment component 24. the include angle to the horizontal of the combiner at the time of an activity — θ it is . The leg 23 which can be adjusted is formed in the base of the body section 22 if needed, and this leg 23 is held in the installation (for example, on the dashboard of a car) of HUD. In the body section 22, it is ZnGa 2O₄ as the circuit section 25 and a fluorescent substance. : It is incident angle θ_i about the light 3 which it has the source 21 of an information display which has a fluorescent display using Mn, and includes information towards a combiner. It irradiates. This light is angle-of-diffraction θ_d by the hologram. Reflection diffraction will be carried out and it will be checked by looking by the observer (for example, operator) 1 as a display image 10 of operation information.

[0022] When using the holographic display of this invention for vehicles, as information which should be displayed, it is suitably chosen by the display application and the information on ancillary devices, such as a speed meter of a car, a tachometer, a shift-lever display, further various warning lamps, and navigation information, an air-conditioner, audio equipment, etc. is mentioned as an example. Moreover, of course, it is also possible to display the information from the outside of cars, such as a traffic information and motor pool opening information. By the aircraft or marine vessel, various information in connection with operation and operation of a vehicle, such as a location and bearing information, such as LAT, LONG, altitude, and a travelling direction, and weather intelligence, obstruction information on a radar, information on a fish detector, can be considered. Moreover, although an observer is mainly the driver of vehicles, such as a car, all the fellow passenger of a passenger seat and others and these persons can be included.

[0023] The holographic display of this invention can be used for various applications besides the example applied to HUD for the above-mentioned automobiles. For example, it can use also for the holographic display which has arranged the hologram in the dark color ceramic paint section of the windshield circumference of an automobile. In this case, the dark color ceramic paint section absorbs solar heat, and since temperature fluctuation is sharp, especially the configuration of this invention is effective. Moreover, it is widely applicable to a display at large [using holograms such as a virtual-image corner marker which directs the corner of a car,].

[0024]

[Example] The example which applied hereafter the display of this invention shown in drawing 3 to the another every mold HUD is explained. A combiner 20 really fabricates acrylic resin to a hologram, and produces it to it. The combiner 20 is supported to revolve by the body section 22 of HUD free [rotation] through the attachment component 24. The include angle to the horizontal of the combiner at the time of an activity is $\theta = 75^\circ$.

[0025] A fluorescent display 21 contains a driver circuit on a semiconductor chip, and is ZnGa 2O₄. : What formed Mn fluorescent substance in the shape of a dot matrix was used. The size of the number of dots is 44x11mm in 128x32. Incidence of the light emitted from the fluorescent display 21 is carried out to a combiner 20 at $\theta_i = 20^\circ$, and it is diffracted at $\theta_d = 20^\circ$. Distance r_i from a fluorescent display 21 to a combiner 20 It is 80mm and is the distance r_d from the combiner 20 to the display image 10. It is about 200mm. The diffracted-wave length of a hologram is about 505nm, and the bright display image was obtained by doubling with the luminescence wavelength of a fluorescent display.

[0026] The above-mentioned hologram is exposed so that reflection diffraction of the light with a

- wavelength of about 505nm which carried out incidence at 20 degrees of incident angles may be carried out at 20 degrees of angle of diffractions. In this case, what is necessary is to carry out incidence of the light from the two light sources for exposure which emit light with a wavelength of about 505nm beforehand to hologram sensitive material at 20 degrees of incident angles, to carry out incidence of the light from the light source for exposure which emits the light of the wavelength which is not 505nm to hologram sensitive material by incident angles other than 20 degree, and just to produce the hologram of the above-mentioned diffraction property by the various technique at the time of exposure of a hologram. Moreover, although the hologram which has one 2.5 times the scale factor with equal incident angle and angle of diffraction of this was used in this example, this invention is not limited to this close outgoing radiation angle and a scale factor.

[0027] Thus, small and a light and thin holographic display without dotage by chromatic aberration were realizable by using a fluorescent display for the source of an information display.

[0028]

[Effect of the Invention] According to this invention, even if it uses a fluorescent display, a holographic display without dotage by chromatic aberration can be obtained. Moreover, even if it changes the playback wavelength of a hologram by manufacture variation or temperature fluctuation, the holographic display with which big brightness lowering does not occur is obtained.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The outline sectional view showing an example of the holographic display of this invention

[Drawing 2] Spectrum drawing of the fluorescent display used with the holographic display of this invention

[Drawing 3] The outline sectional view showing the example of the holographic display of this invention

[Drawing 4] The conceptual diagram showing an example of conventional HUD

[Description of Notations]

1: Observer

3: Light including information

10: Display image

20: Combiner

21: Fluorescent display

22: Body section

23: Leg

24: Attaching part

25: Circuit section

[Translation done.]